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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/625,321
Filing Date: July 23, 2003
Appellant(s): EDIC ET AL.

Floron C. Faries III
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 08 June 2007 appealing from the Office action mailed 04 October 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,229,870 B1	MORGAN	05-2001
5,175,754	CASEY et al.	12-1992
5,383,231	YAMAGISHI	01-1995
6,466,640 B1	TAGUCHI	10-2002

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 9, 17, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) in view of Casey *et al.* (U. S. Patent No. 5,175,754).

With regard to claim 1, Morgan disclosed a method for acquiring a projection data set, comprising: rotating a distributed x-ray source (**B**) about a volume of interest, wherein the distributed x-ray source comprises a plurality of addressable x-ray focal spots (column 5, line 53 - column 6, line 3); emitting x-rays from the distributed x-ray source; and acquiring (**14**) a projection data set comprising a plurality of projections generated from the emitted x-rays.

However, Morgan failed to disclose that the rotational period of the distributed x-ray source is greater than eight seconds.

Casey *et al.* disclosed a commercial CT that has a rotational period of eight seconds (column 1, lines 64-66). Casey *et al.* taught that the number of projections acquired per revolution is determined by the rotational period of the x-ray source. Since the quality of the reconstructed image depends on the number of acquired projections, it is obvious that a longer rotational period would yield better images (column 1, lines 61-62).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to rotate the distributed x-ray source with a rotational period greater than eight seconds, since a person would be motivated to obtain a high quality image by acquiring more projections at a higher angular resolution.

With regard to claim 9, Morgan and Casey *et al.* disclosed the method as recited in claim 1.

However, Morgan and Casey *et al.* failed to disclose a computer program provided on one or more computer readable media, the computer program comprises routines that implement the method as recited in claim 1.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to provide the method in the form of a computer program, since a person would be motivated to implement the method on a CT system that is controlled by a computer.

With regard to claim 17, Morgan disclosed a CT image analysis system, comprising: a distributed x-ray source (**B**) disposed on a gantry (**C**), wherein the distributed x-ray source comprises a plurality of addressable x-ray focal spots (column 5, line 53 - column 6, line 3); a

detector (**14**) comprising a plurality of detector elements; a system controller (**16**) configured to control the x-ray source and to acquire a set of projection data during one or more rotations of the x-ray source about a dynamic object from one or more of the detector elements via a data acquisition system (**18**); and a computer system (**18**) configured to receive the set of projection data.

However, Morgan failed to disclose that the rotational period of the distributed x-ray source is greater than eight seconds.

Casey *et al.* disclosed a commercial CT that has a rotational period of eight seconds (column 1, lines 64-66). Casey *et al.* taught that the number of projections acquired per revolution is determined by the rotational period of the x-ray source. Since the quality of the reconstructed image depends on the number of acquired projections, it is obvious that a longer rotational period would yield better images (column 1, lines 61-62).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to configure the distributed x-ray source to rotate with a rotational period greater than eight seconds, since a person would be motivated to obtain a high quality image by acquiring more projections at a higher angular resolution.

With regard to claim 25, Morgan disclosed a CT image analysis system, comprising: means for rotating a distributed x-ray source (**B**), wherein the distributed x-ray source comprises a plurality of addressable x-ray focal spots (column 5, line 53 - column 6, line 3); means for emitting x-rays from a portion of the distributed x-ray source; and means (**18**) for acquiring a projection data set comprising a plurality of projections generated from the emitted x-rays.

However, Morgan failed to disclose that the rotational period of the distributed x-ray source is greater than eight seconds.

Casey *et al.* disclosed a commercial CT that has a rotational period of eight seconds (column 1, lines 64-66). Casey *et al.* taught that the number of projections acquired per revolution is determined by the rotational period of the x-ray source. Since the quality of the reconstructed image depends on the number of acquired projections, it is obvious that a longer rotational period would yield better images (column 1, lines 61-62).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to configure the gantry to rotate about a volume of interest for eight or more seconds, since a person would be motivated to obtain a high quality image by acquiring more projections at a higher angular resolution.

Claims 2-5 and 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) and Casey *et al.* (U. S. Patent No. 5,175,754) as applied to claims 1 and 9 above, and further in view of Yamagishi (U. S. Patent No. 5,383,231).

With regard to claims 2 and 10, Morgan and Casey *et al.* disclosed the method and the computer program as recited in claims 1 and 9, respectively.

However, Morgan and Casey *et al.* failed to disclose a method that comprises the steps of generating a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data and frequency content of the projection data set, wherein each interpolated projection characterizes the projection data set at a view location of the distributed

x-ray source and at a particular time; and reconstructing the set of interpolated projections to generate one or more images.

Yamagishi disclosed a method for acquiring a CT image of a heart, comprising the steps of generating (**13**) a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data (**12**) and frequency content of the projection data set (the projection data set are acquired at a frequency or time interval), wherein each interpolated projection characterizes the projection data set at a view location of a distributed x-ray source and at a particular time; and reconstructing (**13**) the set of interpolated projections to generate one or more images (column 5, line 53 - column 6, line 30). Yamagishi taught this method is capable of obtaining a three-dimensional image of a heart without motion artifacts (column 2, lines 30-36).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to generate a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data and frequency content of the projection data set and to reconstruct the set of interpolated projections to generate one or more images, since a person would be motivated to obtain a three-dimensional image of a heart without motion artifacts for diagnosis.

With regard to claims 3 and 11, Morgan, Casey *et al.*, and Yamagishi disclosed the method and the computer program as recited in claims 2 and 10, respectively, further comprising associating two or more images to generate a volume rendering (Morgan **22**).

With regard to claims 4 and 12, Morgan, Casey *et al.*, and Yamagishi disclosed the method and the computer program as recited in claims 2 and 10, respectively, wherein the volume of interest comprises a heart having a cardiac period (Yamagishi).

With regard to claims 5 and 13, Morgan, Casey *et al.*, and Yamagishi disclosed the method and the computer program as recited in claims 4 and 12, respectively.

However, Morgan, Casey *et al.*, and Yamagishi failed to disclose a rotational period is approximately a multiple of the cardiac period.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to set a rotational period that is approximately a multiple of the cardiac period, since a person would be motivated to acquire projection data set that comprises several complete cardiac periods.

Claims 6, 7, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1), Casey *et al.* (U. S. Patent No. 5,175,754), and Yamagishi (U. S. Patent No. 5,383,231) as applied to claims 2 and 10 above, and further in view of Taguchi (U. S. Patent No. 6,466,640 B1).

With regard to claims 6 and 14, Morgan, Casey *et al.*, and Yamagishi disclosed the method and the computer program as recited in claims 2 and 10, respectively.

However, Morgan, Casey *et al.*, and Yamagishi failed to teach that the step of interpolating the projection data set comprises reducing statistical noise in the projection data set.

Taguchi disclosed a method of interpolating the projection data set that reduces statistical noise in the projection data set (column 15, lines 4-34).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to reduce statistical noise during interpolation, since a person would be motivated to obtain an image without noise.

With regard to claims 7 and 15, Morgan, Casey *et al.*, Yamagishi, and Taguchi disclosed the method and the computer program as recited in claims 6 and 14, respectively, further comprising reducing an x-ray dose applied to the volume of interest in response to the reduction in statistical noise (column 15, lines 4-34).

Claims 18-21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) and Casey *et al.* (U. S. Patent No. 5,175,754) as applied to claims 17 and 25 above, and further in view of Yamagishi (U. S. Patent No. 5,383,231).

With regard to claim 18, Morgan and Casey *et al.* disclosed the CT image analysis system as recited in claim 17.

However, Morgan failed to disclose a computer system configured to generate a set of interpolated projections by interpolating the set of projection data using a set of concurrently acquired phase data and the frequency content of the set of projection data, wherein each interpolated projection characterizes the projection data set at a view location of the distributed x-ray source and at a particular time and to reconstruct the set of interpolated projections to generate one or more images.

Yamagishi disclosed a computer system (**13**) that generates a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data (**12**) and frequency content of the projection data set (the projection data are acquired at a

frequency or time interval), wherein each interpolated projection characterizes the projection data set at a view location of a distributed x-ray source and at a particular time; and reconstructs the set of interpolated projections to generate one or more images (column 5, line 53 - column 6, line 30). Yamagishi taught this computer system is capable of obtaining a three-dimensional image of a heart without motion artifacts (column 2, lines 30-36).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to provide a computer system disclosed by Yamagishi, since a person would be motivated to obtain a three-dimensional image of a heart without motion artifacts for diagnosis.

With regard to claim 19, Morgan, Casey *et al.* and Yamagishi disclosed the CT image analysis system as recited in claim 18, wherein the computer system is further configured to associate two more images to generate a volume rendering (Morgan **22**).

With regard to claim 20, Morgan, Casey *et al.*, and Yamagishi disclosed the CT image analysis system as recited in claim 18. Claim 20 fails to set forth additional structural limitation. Consequently, claim 20 is rejected with claim 18. MPEP § 2115.

With regard to claim 21, Morgan, Casey *et al.*, and Yamagishi disclosed the CT image analysis system as recited in claim 20, wherein a rotational period of the distributed x-ray source is approximately a multiple of a cardiac period (a cardiac period is approximately one second).

With regard to claim 26, Morgan and Casey *et al.* disclosed the CT image analysis system as recited in claim 25.

However, Morgan and Casey *et al.* failed to disclose means for generating a set of interpolated projections using a set of concurrently acquired phase data and the frequency

content of the projection data set, and means for reconstructing the set of interpolated projections to generate one or more images.

Yamagishi disclosed means (**13**) for generating a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data (**12**) and frequency content of the projection data set (the projection data are acquired at a frequency or time interval), wherein each interpolated projection characterizes the projection data set at a view location of the gantry and at a particular time; and means (**13**) for reconstructing the set of interpolated projections to generate one or more images (column 5, line 53 - column 6, line 30). Yamagishi taught these means are capable of obtaining a three-dimensional image of a heart without motion artifacts (column 2, lines 30-36).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to provide means for generating a set of interpolated projections and means for reconstructing the set of interpolated projections to generate one or more images disclosed by Yamagishi, since a person would be motivated to obtain a three-dimensional image of a heart without motion artifacts for diagnosis.

Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1), Casey *et al.* (U. S. Patent No. 5,175,754), and Yamagishi (U. S. Patent No. 5,383,231) as applied to claim 18 above, and further in view of Taguchi (U. S. Patent No. 6,466,640 B1).

With regard to claim 22, Morgan, Casey *et al.*, and Yamagishi disclosed the CT image analysis system as recited in claim 18.

However, Morgan, Casey *et al.*, and Yamagishi failed to disclose a computer system configured to generate a set of interpolated projections, wherein generating a set of interpolated projections reduces statistical noise in the set of projection data.

Taguchi disclosed a method of interpolating the projection data set that reduces statistical noise in the projection data set (column 15, lines 4-34).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to configure the computer system to reduce statistical noise during interpolation, since a person would be motivated to obtain an image without noise.

With regard to claim 23, Morgan, Casey *et al.*, Yamagishi, and Taguchi disclosed the CT image analysis system as recited in claim 22, wherein the computer system is further configured to reduce an x-ray dose applied to the volume of interest in response to the reduction in statistical noise (column 15, lines 4-34).

(10) Response to Argument

A. Ground of Rejection No. 1:

Claims 1, 9, 17, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) in view of Casey *et al.* (U. S. Patent No. 5,175,754).

Features of Independent Claims Missing from the References

The appellants argue that the references fail to disclose a rotational period of greater than eight seconds. Specifically, Casey *et al.* only disclosed a rotational period of eight seconds (column 1, lines 64-66). The examiner would like to point out that this is only an example. The

rotational period of a computed tomography (CT) system is the time required to rotate an x-ray source and an x-ray detector 360° around an object being imaged. The x-ray source and the x-ray detector are mounted on a rotatable gantry (column 1, lines 23-44). X-ray images or projections are acquired at equally spaced angular positions around the object while the x-ray source and the x-ray detector are being rotated (column 2, lines 6-13). Subsequently, the projections are processed to reconstruct a tomographic image (column 1, lines 45-56). For an eight second rotational period, 7872 projections per rotation are acquired (column 1, lines 64-66), which results in an angular separation of about 0.05° between projections; whereas a rotational period of only two seconds, permitting only acquisition of only 1968 projections (column 1, line 66 - column 2, line 1), increases the angular separation to about 0.18° (column 2, lines 6-13). Casey *et al.* taught that the quality of a tomographic image depends on the number of projections acquired (column 1, lines 61-62). Therefore, it is known to a person of ordinary skill in the art that a slower rotation will result in a higher resolution. The availability of fewer projections results in a tomographic image having a low resolution (column 2, lines 1-2). Conversely, a tomographic image of higher resolution could be reconstructed based on more available data. Recognizing this fact, a person skilled in the art would be motivated to optimize the rotational period such that a tomographic image of appropriate resolution is obtained. Furthermore, it would be within the capabilities of a person skilled in the art to employ a rotational period of greater than eight seconds to achieve the predictable result of a tomographic image of even higher resolution. Using a known technique to achieve a predictable result would have been obvious to one of ordinary skill in the art. *KSR International Co.* v. *Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007).

Improper Combination - Impermissible Hindsight

The appellants argue that there is no motivation to combine the references. Specifically, the appellants allege that impermissible hindsight was employed in combining the references. The examiner respectfully disagrees. The rationale to combine is provided by Casey *et al.* As discussed above, Casey *et al.* disclosed a technique that would allow a person skilled in the art to adjust a resolution of a tomographic image. Employing a rotational period greater than eight seconds would be obvious to a person skilled in the art if a tomographic image of higher resolution were required. The appellants further argue that the reasoning given by the examiner may only be true in limited circumstances as described by Casey *et al.* This argument is not persuasive as it fails to invalidate the reasoning even if it may only be true in limited circumstances.

The appellants argue that Morgan taught decreasing the period (column 5, line 65 - column 6, line 1). The examiner respectfully disagrees. Morgan described conventional CT imaging, which involves obtaining a plurality of slice images sequentially (column 1, lines 21-31). One drawback to this type of imaging is the relatively long time necessary to generate a large plurality of image slices, thereby causing the first image slice and the last image slice to be acquired at significantly different times (column 1, lines 26-31). Morgan disclosed using multiple fan beams to simultaneously acquire a maximum number of image slices in the shortest time, which has nothing to do with shortening the rotational period.

The appellants allege that there is no evidence to show that the commercial CT disclosed by Casey *et al.* is capable of acquiring projection at more than 7872 angular positions in one

rotation. This argument is not persuasive. First of all, the appellants have not provided any support for this allegation. Secondly, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). The disclosure of Casey *et al.* was only relied upon to teach the relationship between a rotational period and the quality of a tomographic image. One of ordinary skill in the art would recognize the fact that a longer rotational period would necessarily require a CT capable of acquiring and processing additional projections. Modifying and/or upgrading a CT to accommodate additional projection data is well within the capabilities of a person skilled in the art.

Improper Combination - The References Teach Away

The appellants argue that Morgan taught away from using a rotational period greater than eight seconds. The examiner respectfully disagrees for the same reason discussed above.

B. Ground of Rejection No. 2:

Claims 2-5 and 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) and Casey *et al.* (U. S. Patent No. 5,175,754) as applied to claims 1 and 9 above, and further in view of Yamagishi (U. S. Patent No. 5,383,231).

The appellants do not separately argue claims 2-5 and 10-13, and therefore these claims are considered to be unpatentable for the reason set out in the rejection of record.

C. Grounds of Rejection No. 3:

Claims 6, 7, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1), Casey *et al.* (U. S. Patent No. 5,175,754), and Yamagishi (U. S. Patent No. 5,383,231) as applied to claims 2 and 10 above, and further in view of Taguchi (U. S. Patent No. 6,466,640 B1).

The appellants do not separately argue claims 6, 7, 14, and 15, and therefore these claims are considered to be unpatentable for the reason set out in the rejection of record.

D. Grounds of Rejection No. 4:

Claims 18-21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1) and Casey *et al.* (U. S. Patent No. 5,175,754) as applied to claims 17 and 25 above, and further in view of Yamagishi (U. S. Patent No. 5,383,231).

The appellants do not separately argue claims 18-21 and 26, and therefore these claims are considered to be unpatentable for the reason set out in the rejection of record.

E. Grounds of Rejection No. 5:

Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morgan (U. S. Patent No. 6,229,870 B1), Casey *et al.* (U. S. Patent No. 5,175,754), and Yamagishi (U. S.

Patent No. 5,383,231) as applied to claim 18 above, and further in view of Taguchi (U. S. Patent No. 6,466,640 B1).

The appellants do not separately argue claims 22 and 23, and therefore these claims are considered to be unpatentable for the reason set out in the rejection of record.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Allen C. Ho

Allen C. Ho

Conferees:

Edward J. Glick

Georgia Y. Epps